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ABSTRACT

Science education has become one of the priorities of education in the United States. Teachers in several schools have begun to use science kits as one tool to assist them in teaching science. Despite the wide use of science kits, little has been done to determine their effectiveness in promoting science learning. The purpose of this paper is to show how the use of science kits has affected students learning and attitudes toward science in several schools in Southwest Michigan. The subjects of this study were 397 teachers using science kits in elementary schools. A questionnaire was mailed to participating teachers. Fifty-four percent of the teachers returned the survey to report on their classroom observations. Findings indicate that science kits have increased student interest in science, and improved achievement and understanding of science concepts and processes. No differences in results were reported for minority students and female students. (Author/ZWH)

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Western Michigan University

Science and Mathematics Program Improvement

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Effects of Science Kits on Attitudes and Accomplishment of Students in Science

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Abstract

Science education has become one of the priorities of education in the United States. Science kits are one of the tools used to assist teachers in teaching science in several schools. Kits have been used for approximately two decades. However, they have rarely been evaluated to determine their effectiveness in promoting science learning. The purpose of this paper is to show how the use of science kits has affected students learning and attitudes toward science in several schools in Southwest Michigan.

The subjects of this study were 397 teachers using science kits in elementary schools. A questionnaire was mailed to participating teachers. Teachers were asked to report on what they had observed and asked to give examples to support their responses. Fifty-four percent (214) of the teachers returned the survey.

Findings indicate that science kits have increased student interest in science, and improved achievement and understanding of science concepts and processes. No differences in results were reported for minority students and female students.

Effects of Science Kits on Attitudes and

Accomplishment of Students in Science

Science teaching and learning have become one of the priorities of education in the United States. Shaw (1993) in a newspaper article, reported that the average percentage of questions answered correctly by a 13-year-old American students was 67%. She contends that American students are far behind equivalent students from countries such as Korea, Taiwan, Switzerland, and former Soviet Union, among others, in mathematics and science. This has motivated the interest in improving science achievement among all students. Thus, the fourth educational goal formulated by ex-president George Bush, in "America 2000," establishes: "By the year 2000, U.S. students will be first in the world in science and mathematics achievement"(Bush, 1991; p. 63). This goal sets a clear direction for reform in teaching science, especially in the early grades, when it establishes: "Math and science education will be strengthened throughout the system, especially in the early grades"(Bush, 1991; p. 63). Improving scientific achievement requires the involvement of all entities that may collaborate with the school system or contribute financially and academically. In Michigan, The W.K. Kellogg Foundation has become involved through the Kellogg Science Education Initiative,

in support of different strategies and innovations to increase the excellence of science education in the State (Barley, Jenness, Pearl & Rubino, 1991). Kellogg Foundation has awarded funds to selected educational agencies to promote greater scientific literacy among Michigan citizenry. The focus of the intervention has been on upper elementary levels (grades 4 - 6).

One of the strategies used to address these problems in several of the projects supported by the Kellogg Science Initiative, is the development and provision of science kits. Raw (1982) establishes that the appearance of kits seems to be related to the absence of "hands-on" experiences with science equipment. Science kits have been used in science education for several years. Bales (1972) reported the development of auto-tutorial science kits for Mexican-American students based on science contents and processes, designed with the collaboration of teachers, student teachers, college scientists, and science faculty; Leeper (1972) wrote about Fairfax County (Virginia) experiences in the development of science kits and training of teachers in the use of kits; and Heimler (1972) pointed out how auto-instructional kits were developed around science concepts and principles and how these kits increased individualized and active learning. Perisi (1975) developed science kits around topical areas for kindergartens working with the

students. Later, in 1984, Zimbawbe University developed science kits for different topics (water, rocks, plants, electricity, etc) to be used in teaching science in the secondary level; and more recently, Butler (1989) developed a chemistry kit to teach differences between physical and chemical changes to fourth graders that includes objectives, vocabulary, teacher background information, lessons, quizzes, an unit test, and supplementary information about chemistry.

In Michigan, the projects funded by Kellogg Foundation have organized kits differently. One of the projects organized kits around specific themes for each grade level, selected after reviewing the existing curriculum, based on Michigan state science objectives; another project organized kits by topics with specific activities in each topical area for several grade levels; and a third project organized them around the existing science curriculum by grade level and science thematic areas.

Kits were developed by project staff and teachers, who drew materials from local and national science projects. These kits were used by teachers who had been in an inservice workshop to learn about how to use them (Barley, Jenness & Rubino, 1992).

The kits used by teachers and students in this study include booklets with

appropriate science background material, activity instructions, objectives/outcomes, materials/supplies and equipment. Students complete the activities proposed in the booklet under the guidance of the teacher.

Perisi (1975) based on her experience, establishes that science kits encourage children to become actively involved in learning of science. Consequently, kits may increase student understanding and attitude toward science. However, they have been rarely evaluated in relation to their effectiveness to promote science learning. The purpose of this paper is to show how the use of science kits has affected students learning and attitudes toward science in several schools in Southwest Michigan.

Methods and Procedures

Subjects

The subjects of this study were 397 teachers, whose names were supplied by the three different educational agencies that participated in the survey. One of the agencies was located in an inner-city area, and the other two in mid size cities. Teachers were involved in science activities using science kits in elementary schools. Teachers participated in some level of inservice activities prior to the use

of the kits. Of the 397 teachers surveyed, 214 returned the survey (54% return).

Instrument

A three-page questionnaire was mailed to participating teachers in late Spring 1992. It concentrated on the effects of science kits on teachers and students. The survey asked teachers to report on what they had observed. Teachers were asked for examples to support their responses if they indicated improved student achievement, changed student attitudes, or other positive responses.

Results

Teachers responses about the effects they observed on students as a result of the kit program are shown in Table 1.

Table 1. Effects of Kits on Student Response to Science

Since you began to use kits in the school have you seen...	SOME/A LOT(%)	LITTLE (%)	NO (%)
an increased interest in science by your students?	97	1	2
improved overall science achievement by your students?	88	4	8
improved understanding of science concepts?	92	7	1
improved understanding of science process?	90	6	4
improved understanding of the application of science to the real world?	90	3	7

Overall, 90 percent or more of the teachers responded that they have seen increased interest or improved understanding of science in their students since they began to use the kits. A smaller but still significant group, 88 percent, have seen improved overall science achievement.

Comments related to students' increased interest in science were received from 132 teachers; 37 percent of these respondents indicated that students show eagerness to learn about science, affirm they like science, enjoy science activities, and become excited when they have science activities. Some examples are

> *They are very excited each time I say we'll be doing an experiment.*
>
> *Students looked forward to science each day and would ask what we would be doing today.*
>
> *[Students] cheer when they see the new gray kit, students ask when are we going to do more experiments?*
>
> *They enjoy the activities.*
>
> *Kids applaud and are happy when asked to get out their science booklets, [they] give lots of positive comments.*

In relation to improved science achievement by the students, 95 teachers wrote in comments. Many teachers (36) said that after using kits students ask and answer more science questions, participate more in discussions, do more hands-on

activities voluntarily, and talk more about science. Some comments are:

> *The students are asking questions relevant to topics covered in class and doing independent research.*
>
> *They talk about what they have learned easily.*
>
> *[Students show] enthusiasm with materials and their use.*
>
> *Their interest and questions are relevant and thoughtful.*

Being able to assess science achievement when you are teaching for understanding rather than remembering facts is a skill many teachers still need to master. Twenty-four teachers wrote in that they cannot say, or they do not have a way to compare achievement, although they perceived improved overall science achievement by their students.

Sixty out of 95 teachers said that they have seen an improved understanding of science concepts. They said that students discuss, write, describe, show comprehension, and apply science concepts to different situations. Some comments that support these affirmations follow:

> *Students were able to use some of the terminology used in science and explain it to other adults.*
>
> *Children talk about trying experiments at home such as with sound and light.*

[They have] new vocabulary science-related, new understanding of how things work.

[They] refer to and use concepts even after we have covered them in class.

They ask better questions.

They are relating what they have learned to other situations.

Comments about improved student understanding of science process were received from 73 teachers, 37 indicated that students discuss and answer questions about science, show understanding and use scientific processes, and are able to write research results. Some illustrative comments are:

[Understanding] was demonstrated in the high quality of their science fair projects.

Responses to questions show more evidence of using the scientific process to arrive at conclusions.

Children used process in doing projects that incorporated many learned concepts.

[Students show] improved understanding because they talk about it [science] and write about it, and find articles about it.

[Students make] use of predictions first followed by actual application of concepts.

Seventy-seven teachers wrote in comments related to improved

understanding of the application of science concepts to the real world. Thirty-six teachers said that students now understand and describe science concepts, their relation to other technologies, and their use in different contexts. Some comments are:

Students are now better able to describe concepts involved in certain technologies.

They have been held accountable for many at-home related activities. Many have been surprised to think of everyday experiences in relationship to science.

[Students are] applying [science] to everyday situations.

Students go home and apply the lessons to activities they can do at home.

Children are bringing in items they find to share, also discuss things they have seen (TV, home).

When asked whether the effects of kits on minority students differ, many teachers did not respond. In part, this may reflect teachers who do not have minority students in their classes. Of those who responded (109), 99 percent indicated that minority students respond positively to science kit-related activities; 85 percent believe that minority student science achievement is improving (see Table 2).

Table 2. Effects of Kit Activities on Minority Students

QUESTION	YES %	NO %
Are attitudes toward science the same for minority students as others in your class?	93	7
Do minority students respond positively to science kit-related activities?	99	1
Is minority student achievement in science improving?	85	15

Comments were received from 109 teachers related to the similarity of minority students' attitudes toward science when compared with other students in their classes. Sixteen percent of the respondents reaffirmed that all students participate equally in science activities; 27 percent of the respondents said that they observed and perceived that all children like science; and 17 percent said that they show enthusiasm, motivation, and interest for science, related areas, and materials.

One hundred seventy eight of the 214 teachers responded to the question about how positively girls are responding to science and 106 to the question about achievement. Again, there was a larger than usual non-response rate for these items. Of those responding, 99 percent said that girls responded positively, and 84 percent that girls' science achievement is improving (see Table 3).

Table 3. Effects of Kit Activities on Girls

QUESTION	YES (%)	NO (%)
Do girls respond positively to science kit-related activities?	99	1
Is science achievement for girls improving?	84	16

Ninety teachers wrote in comments related to girls' responses to science kit-related activities, with 62 percent of them indicating that girls' show a positive attitude toward science when participating in class discussions, and show interest and involvement in science activities. Eight percent said there is no difference between girls and boys in their response to the activities. Some comments are:

[As to girls] attitudes, more girls entered the science fair this year.

[Girls are] eager to respond in class and in group discussions.

They [girls] appear to be as eager and enthusiastic as the boys.

Enthusiasm and exactness to detail by girls often exceeds that of boys.

Several girls talk about being scientists when they grow up. They take the time to make careful observations in science activities.

More girls are trying to do experiments and try things on their own.

They get just as involved as boys, also choose science as a free choice activity.

Comments were received from 64 teachers as to how they perceive girls' achievement in science has improved. Fifteen (17%) said they do not have data to support the affirmation nor do they have a measure to assess the improvement; 15 (17%) teachers said they know that girls improved through their own observations and other teacher and parent comments; 19 (22%) said that boys and girls have similar achievement in science; and 15 (17%) said that girls have increased their test scores.

Conclusion

Teachers who responded to the survey were strongly positive about the effects of science kits on students attitudes and accomplishment toward science. Science kits have increased student interest in science, improved achievement and understanding of science concepts and processes. Science kits are related to increased voluntary students participation in science activities and in class discussions, more frequent conversations about science, ability to write research results and to answer science questions, and ability to apply science concepts to the real world. Similar results were found for minority students and female students. Science kits were related to positive attitudes toward science, and increased achievement and understanding of science concepts and processes by

minority and female students. The data collected are teacher reports of their own observations. It is important, therefore, to read the comments teachers provided as to how they know students are gaining. This study provides only excerpts from a large number of teacher responses that suggest that the very important first step toward scientific literacy have begun in the schools funded by the Kellogg projects. Follow-up surveys are planned to track the progress of teachers and their students.

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